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Knowledge, Attitudes and Practices on Consumption of Contaminated Farm Produce by Aflatoxin in the Counties of Meru and Tharaka Nithi, Eastern Region of Kenya

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Abstract

The objective of the study was to examine knowledge, attitude and practices of the community regarding the dangers of consuming farm products infested by aflatoxin. The study setting was in two rural counties in the eastern ecologic zone of Kenya. Methods employed the use of a semi-structured questionnaire which was presented face to face to respondents at household level. Data were collected and entered via kobo tool kit into smartphones, identifying the geo-position of each household. A total of 718 households respondents provided information on the education level of heads of households, income, knowledge on aflatoxin, practices on handling farm harvested produce, and their attitude towards management of any spoilt produce. Results showed that only 37% of respondents knew what aflatoxin is. Only 26% of the respondents could identify aflatoxin-contaminated grain by colour. In practice, 56% reported that they fed the spoilt or rotting grain to their domestic animals and birds. The study conclusion was that the rural small-scale farmers in the study zones were not well informed that aflatoxin-contaminated grain consumed directly from spoilt grain or indirectly via animal products could gravely cause illness, poisoning or death.

Keywords

Aflatoxin Poisoning, Aflatoxin-Contaminated Animal Products, Attitude, Household Practice, Knowledge, Moisture-Laden Cereal Grain, Storage

INTRODUCTION

Food security is a key component to wellbeing as discussed at the "World Food Summit" and frequently mentioned in FAO and partners reports [4]. Definition of food security includes physical wellbeing, the need for individuals to have economic access to sufficient food that is safe and adequate to meet nutritional needs as per their activity and health needs. This paper focuses on the objective that sought to investigate knowledge, attitude and practices of the households concerning the management of postharvest staple maize crop which is the principal food crop in the study region. The paper presents aflatoxin contamination of grain (maize) grown in two counties located in Eastern Kenya and thereby show aflatoxin contamination threats to food and nutrition security in households of rural small farmer communities. Data collected to address this study objective was intended to open an opportunity to do an intervention on building awareness and mitigation processes to help reduce the challenges of aflatoxin in the study geographic study areas.

BACKGROUND

This was a cross-sectional study that was conducted in the Eastern geographic region of Kenya specifically in the counties of Meru and Tharaka Nithi. Meru county lies within the latitude of 1.00'N and 38000E [22]. Meru County has four ecologic zones and has an altitude between 2230 and 2900 meters above sea level. The upper highlands of Meru get an average of 700mm to 1000mm of rain per year. This ecologic zone while good for crop growth presents challenges in managing post-harvest crops in terms of appropriate moisture containment for dry grain. Tharaka Nithi is also located in the eastern part of Kenya. The county lies between latitudes 000 071 and 000261 south and between longitudes 370190 and 370 460 east. It borders Meru County as well as other counties (Embu, Kirinyaga, and Kitui). It covers 2,662.1 Km2 including 360km2of Mt Kenya [17][6]). Both study counties were identified as climatically and agri-ecologic zones with soils that produced very high levels of aflatoxin [15].

Food and nutrition security is a global challenge. In 2016 FAO predicted that the global population will reach 9.1 billion people by 2040 leading to food demand that will be

70% greater than it is today.

In other reports, [4] stated that the world is not on target for achieving zero hunger by 2030. As the global population grows, it was estimated that 2 billion people (23.9%) of the global population did not access nutritious food in 2019 [3]. Data for sub-Saharan Africa showed that between 2015 and 2017, the eastern Africa region had 132.7 million people who had major food deficits [4]. Africa's challenges that contribute to food insecurity are food losses (Alexandros and Bruisma, 2012) due to climatic processes, losses through the entire agricultural food chain including poor post-harvest management especially the inability to dry and store grain in dry and properly ventilated storage.

Both study counties depend on agriculture for food, socio-economic activities and employment. County records from Meru show that about 80% of the population that are also small-scale farmers depend on agriculture on their livelihoods and that the agricultural sector contributes about 80% of household income [13]. Maize is the key staple food grown on 14.5% of the county's productive farmland [13]. Tharaka Nithi's economy also depends very largely on agriculture. Available reports show that more than 40% of the county's population live below the poverty line of <1 US $ per day [14]. Data shows that in Tharaka Nithi, approximately 80% of the population depends on small scale agriculture for their livelihoods[14].

Aflatoxin is a technical term that does not have a common term in the Kenyan vernacular. However, the fungal /mouldy growth in seeds particularly cereals and cereal products and nuts is well known. Farmers are familiar with "moulds" some of which are known to be poisonous and others that they consider harmless. Knowledge and awareness of dangers associated with the consumption of aflatoxin-contaminated seeds, processed foods and animal products are limited especially in rural households. Several years ago, reports of aflatoxin poisoning were reported in Kenya [18][12]. Later severe poisoning (317 cases) and death of 125 people occurred in several districts of eastern Kenya [2]. During that reporting period, there was serious poisoning with extremely high levels (above 1,000 ppb) of aflatoxin in the maize grain. In a closely related study, Onsongo et al. (2005) reported acute hepatitis that had been caused by aflatoxin. Protection of small-scale farmer households from aflatoxin poisoning requires knowledge, change of perception and practice in post-harvest management[19].

METHODOLOGY

Two Counties Meru and Tharaka Nithi, from the eastern ecologic zones of Kenya, were purposefully selected due to increased reported incidences of aflatoxicosis, especially through contamination of maize (Nikal et al, 2004; [12][16]). The objective of this study was to investigate the community's knowledge of dangers associated with the consumption of aflatoxin-contaminated staple food. It was an investigation within a larger study on food and nutrition security and the impact of aflatoxin on food and nutrition security.

A two-stage cluster sampling procedure was adopted. County administrative boundaries and enumeration areas were retrieved from a list of all counties, sub-counties, and villages. This cluster methodology was used by the Kenya Bureau of Statistics [9]. A listing of all households in each enumeration area served as the sampling frame for the second stage of household's selection through a systematic sampling procedure. The sample size of households for the study was computed by treating the two study regions as one domain. The size of sampled households was distributed according to the proportion of households in each county. Questionnaires were developed and content was validated through panels of technical experts. The reliability of instruments was determined through pilot testing in clusters from an adjacent county. At interview stage, each head of the household was asked if they knew what aflatoxin is, if they were knowledgeable on dangers regarding consumption of food that had mould/fungi, and if they fed domestic animals or poultry grain that appeared spoilt or mouldy. Each respondent represented a household and was also asked to respond on practices on storage of grain and processed cereal staple food (maize flour and other cereal mixtures used to feed young children). Data were collected at the household level using the kobo tool in smartphones and transmitted to a server. The data were analyzed using households as a unit of study and reporting. SPSS Statistics (version 28) package was used to analyze the data.

RESULTS

Combined results of the two study counties, (Table 1) show that 63% of households did not know what aflatoxin is. Proportionately, results examined at each county level showed that in Meru where more households were sampled 46% of the households did not know what aflatoxin was, whereas in the Tharaka Nithi County the proportion of those who were not knowledgeable was 18%. The majority of the respondents (65%) reported that they did not know how to identify grain that was infested by aflatoxin. Slightly more than one quarter (26%) of respondents from both counties said that the change in colour of the grain was what informed them that the grain was infected.

Table 2 shows results of awareness level of head of household by their education level. From the numbers in the study, the respondents who had primary school level (8 years of schooling) of education were the majority 418 (85.8%). The majority of these 58.2% said moldy food was not good. The same response trend was observed among the ones with secondary school level of education and the higher education category of respondents.

Table 1. Do you know what aflatoxin is?

COUNTY							
Description		MERU		THARAKA NITHI			
		N	%	N	%	N	%
Knowledge of Aflatoxin	N	327	46	128	18	455	63.5
	Y	160	22	102	14	262	36.5
How do you identify aflatoxin infested grain?	Don't Know	334	47	135	19	469	71.4
	By Colour	104	15	84	12	188	28.6

Table 2. Knowledge/Awareness of negative effect of aflatoxin by education level

		Level of Education										Total
		Primary		Secondary		Tertiary		Bachelor's Degree		Post-Graduate		
		Mouldy Food is not Good										
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	
County	Meru	55	296	29	75	5	19	2	6	0	0	487
	Tharaka Nithi	21	122	0	69	0	15	0	2	0	1	230
Total		76	418	29	144	5	34	2	8	1	1	718

Table 3. Practice: Handling of spoilt grain

		How Households Deal with Spoilt Grains									
		Remove Mold and Dry		Use Unaffected		Feed Animals		Give		Throw	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
County	Meru	475	12	464	23	199	289	483	4	280	207
	Tharaka Nithi	226	4	226	4	115	115	228	2	113	117
Total		701	16	690	27	314	404	711	6	393	324
Please note that the methods of disposal of mouldy grain had some overlap in the responses, that is, a household could separate what they considered as unaffected, feed the portion to animals, but would also give away some of the grain. The participants were asked which of the methods in Table 3 above they used to deal with moldy food and response of yes (if they used the method) or No (if they didn't use the method) was required.											

The question on practice (Table 3) was based on what each household does if they found grain that they considered "spoilt" through the formation of mould which was viewed as potential aflatoxin contamination. The majority (Table 3) said they would feed the domestic animals or poultry with what was considered "spoilt" grain. A good number of respondents said they would not throw away the visibly spoilt grain although a similar proportion would throw the spoilt grain away.

DISCUSSION

The findings from this study showed that a large proportion (63%) from both study counties did not know what aflatoxin was. A majority (65%) also said they did not know how to identity aflatoxin infection on the grain, nuts or processed foods such as flour for household use. Limited knowledge of aflatoxin presence in farm produce was documented in the Eastern Democratic Republic of Congo as well (Undomku et al 2018). When the description of aflatoxin-contaminated food was termed as "mouldy", they were more positive responses to the knowledge.

The knowledge of "mouldy" spoilage was similar across the different levels of education. This shows that awareness was quite good across the groups. Being aware of status may not necessarily translate to knowledge. In this study, the results on practice do not reflect knowledge. Results on practice showed a poor understanding of the imminent danger as the majority of respondents said they would feed their domestic animals with spoilt mouldy grain. Once domestic animals or birds consume the toxins in the grain, the poisons go directly to the animal's body and the same toxins become constituents of the products such as eggs and milk. They also indicated they would just remove what was visible as mould and use the rest of the grain for their food, sale or storage.

Post-harvest losses due to mould formation on the grain have economic, social and health consequences. Kumar and Kalita (2017) examined postharvest losses during storage in developing countries and reported that 50-60% of cereal grains can be lost during the storage stage. Kumar et al (2017) further emphasized that losses during this stage are influenced majorly by, lack of technology and overall inadequate storage infrastructure systems[11]. It has been shown that although Kenya produces reasonably adequate maize stocks, it also imports the same to fill the demand gap mainly because 30% of the harvest is lost at the post-harvest stage (Ndambuki and Ngatia 2006). The hot, humid climatic zones are a challenge for post-harvest management of maize and other crops. Factors that contribute to grain losses at the post-harvest stage include the moisture-laden crop, poor storage and adulteration of cereal grains due to humidity. Apart from maize, other affected crops include sorghum, different nuts such as groundnuts/peanuts, and fresh produce[17]. Such adulterated food stocks are also a threat to both human and animal health especially in relation to aflatoxin contamination. Animals that consume the rotten grain that is prone to aflatoxin contamination leads to the same toxins getting transmitted to humans from products such as milk, meat and eggs [10]. Aflatoxin is known to contribute to poor linear growth (stunting) in young children (Hoffman et al., 2019[1][21][12]. Other serious outcomes caused by aflatoxicosis in Kenya include a major outbreak of aflatoxin poisoning in 2004 when 317 cases were reported and a total of 215 deaths in the eastern districts of Machakos, Kitui and parts of Thika [2]. Much earlier, Onsongo et al. (2005) had also documented acute hepatitis that was also caused by aflatoxin poisoning. A study by Kirino et al. 2016 also reported high-level aflatoxin in milk sold by informal retailers in Nairobi. This study was therefore undertaken to examine, knowledge, attitudes and practices of households in a zone that is well documented to have high levels of aflatoxin in staple cereal crops especially maize and nuts such as groundnuts. Understanding the knowledge, attitude and practices of households is important when packaging interventions to save lives and contribute to sound farm-level economic decisions[10][19].

CONCLUSION

Aflatoxin contamination of cereal grain, nuts, animal feeds is a threat to human health and also minimizes efforts of food and nutrition security. Aflatoxin and has implications in the socio-economic well-being of communities living in eastern zones of Kenya and other regions where hot and humid climatic conditions present challenges in post-harvest management [11].

Over 70% of community households depend on agriculture for their food, nutrition security and livelihoods in the study area. As a result, human health is seriously compromised when high proportions of these communities consume aflatoxin infected foods directly or indirectly through consumption of infected animal products. These toxins in foods such as milk from the infected animal products pose health outcomes in people. As shown in the cited studies in this paper presence of aflatoxin in the soil, grain, nuts and animal feeds is well documented. There is an urgent need to use effective procedures at the agricultural policy level to reduce this challenge which is widespread in the study zones and other regions. A product known as "Aflasafe" is documented by Kenya Bureau Standards (KEBS/org website undated) as a biocontrol intervention that makes aflatoxin-contaminated soil safe (KEBS/org website undated). Small scale farmers need government and partners in the region to help reduce aflatoxin dangers in food[8].

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